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WATER SUPPLY AND WATER QUALITY CONTROL STUDY BELTZVILLE RESERVOIR LEHIGH RIVER BASIN, PENNSYLVANIA

Public Health Service
New York, New York

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WATER SUPPLY AND WATER QUALITY CONTROL STUDY
BELTZVILLE RESERVOIR
LEHIGH RIVER BASIN
PENNSYLVANIA

A Study of Potential Needs and Value of
Water Storage for Municipal, Industrial
and Quality Control Purposes

PRELIMINARY
DRAFT

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region II
New York, New York

for
DEPARTMENT OF THE ARMY
U. S. Army Engineer District, Philadelphia, Pennsylvania

October 1964

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I. INTRODUCTION

Authority

The District Engineer, U. S. Army Engineer District, Philadelphia, Pennsylvania by letter dated May 20, 1963 requested the Public Health Service, Region II, New York to furnish its views and recommendations on the development of water supply and flow regulation for quality control in the proposed Beltzville Reservoir.

This study was made under the provisions of (1) the Memorandum of Agreement, dated November 4, 1958 between the Department of the Army and the Department of Health, Education, and Welfare relative to Title III of P. L. 500, 85th Congress as amended by P. L. 87-88 and (2) the Federal Water Pollution Control Act, P. L. 84-660 as amended by P. L. 87-88.

Purpose and Scope

The purpose of this study is to determine the need for and the value of storage for municipal and industrial water supply, and flow regulation for water quality control in the Lehigh River Basin through the year 2010. The Lehigh River drains 1,364 square miles of eastern Pennsylvania before joining the Delaware River. Major portions of Lehigh, Northampton, and Carbon Counties in Pennsylvania form the Lehigh Basin, as well as minor portions of six other Pennsylvania counties.

Acknowledgments

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Pennsylvania Department of Health

Joint Planning Commission, Lehigh-Northampton Counties, Pennsylvania

City of Allentown

City of Bethlehem

Borough of Northampton

Morris Knowles, Inc. (Easton, Pa. Office)

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II. SUMMARY AND CONCLUSIONS

Summary

1. The Corps of Engineers has proposed the construction of Beltzville Dam and Reservoir on Pohopoco Creek, a tributary to the Lehigh River in eastern Pennsylvania.

2. Beltzville is the first of eight multipurpose reservoirs proposed for development in the Delaware River Basin (above Trenton, New Jersey, the head of the estuary) before 2010. Four of these projects are located in the Lehigh River Basin.

3. Three Pennsylvania counties, Carbon, Lehigh, and Northampton, comprised the study area for economic projections.

4. The area of the Lehigh River Basin is 1364 square miles.

5. The hydrological confines of the Lehigh River Basin were used to limit the area of municipal water supply projections. Population of this area in 1960 was 434,000. Major communities are Allentown (108,000 people) and Bethlehem (75,000 people).

6. Municipal water supplies served 344,000 people with 51 mgd in 1962, indicating an average per capita use of 150 gallons per day.

7. Self-supplied industrial water use in 1963 was estimated to be 470 mgd, with the primary metals industry accounting for the major share of the demand.

8. Municipal and industrial waste loads discharged after treatment to the Lehigh River or its tributaries were estimated to be

29,000 pounds of first stage biochemical oxygen demand in 1962. The major portion of the total load is discharged at Allentown and Bethlehem; however, significant loads are also discharged from communities in Carbon and Luzerne Counties.

Conclusions

1. Population in the municipal water supply study area is expected to reach 800,000 by 2010.

2. Municipal water supplies are expected to serve 700,000 people a total of 150 mgd in 2010, based on an average per capita demand of 215 gallons per day.

3. Of the total demand of 150 mgd, the estimated demand of the numerous small communities in the study area will be 28 mgd in 2010. The estimated present capacity of these communities is 11 mgd. Although it may be possible to satisfy some of the additional demand of 17 mgd from the Beltzville Reservoir it appears more likely that local ground water and local surface supplies will be utilized.

4. The estimated demand for the three major municipal water supply systems (Allentown, Bethlehem, Northampton) in the study area will be 122 mgd in 2010. The continued capacity of their present sources of supply is 72 mgd. Thus, there will be a need to develop additional sources of supply to satisfy the expected increase of 50 mgd.

5. Bethlehem will have to develop additional sources of supply to satisfy an expected increase in demand of 20 mgd. Bethlehem's

demands will exceed their current supplies by about 1975.

6. Bethlehem's future water demands could be satisfied from the Beltzville Reservoir because of the proximity of their existing sources and transmission main. If Bethlehem were to utilize water supply storage in Beltzville to satisfy the 20 mgd demand, the annual benefit would be $253,000.

7. The two remaining major municipal water systems, Allentown and Northampton, will require additional sources of supply to satisfy the expected increase of 30 mgd. (Allentown - 24 mgd, Northampton - 6 mgd). While Beltzville could satisfy this demand, it appears more likely that the Lehigh River or future proposed surface impoundments will be utilized. Accordingly, it is not anticipated that a need for future municipal and industrial water supply will be met from the proposed Beltzville Reservoir. Therefore, no tangible benefits may be attributed to it now.

8. Prior to the initiation of detailed planning on future impoundment projects, the water supply requirements of the Basin communities, particularly Allentown and Northampton, should be re-evaluated to determine the relative desirability of alternate sources.

9. Self-supplied industrial water demands are expected to total 1,615 mgd in 2010.

10. Storage for water supply is not necessary in the proposed Beltzville Reservoir to supply anticipated industrial demands in 2010, provided that streamflows are maintained at existing levels (128 mgd at Bethlehem is the one day mean flow expected once in 50 years), and further, that the major user in the primary metals industry continues to maintain its water intake below its discharge.

11. Municipal and industrial waste loads, after secondary treatment, discharged to the Lehigh River or its tributaries are projected to be 59,000 pounds of first stage biochemical oxygen demand in 2010. This load will cause the dissolved oxygen content of the Lehigh River near Easton, Pennsylvania to be less than 2 milligrams per liter, a highly undesirable condition.

12. The provision of satisfactory water quality in the Lehigh River will enhance the recreational opportunities for more than 400,000 people in the Allentown-Bethlehem area by 2010. Industry will be attracted to the area if satisfactory water quality is provided, assuming other factors are equal. The quality of the Delaware River above Trenton, New Jersey will be improved by any improvements made in Lehigh River quality.

13. Storage of water to provide additional flows during the dry, hot months of the summer and fall will serve to assure improved water quality in the Lehigh River. The annual draft on storage necessary to attain benefits from improved water quality in 24 out of 25 years is estimated to be approximately 110,000 acre-feet.

14. Adequate treatment of wastes must be provided before the benefits from increased flows can be realized.

15. The estimated annual value of the benefits resulting from the provision of approximately 110,000 acre-feet of storage to supply the needed draft, based on the cost of the most likely alternative method of providing the same water quality is $866,000.

16. Of the 110,000 acre-feet needed, the remaining 34,000 acre-feet of storage in the Beltzville Reservoir originally allocated for water supply could be used for water quality control purposes. The estimated annual value of benefits resulting from the provision of this storage, based on the most likely alternative method is $217,000. Benefits from improved water quality will be widespread and general.

III. DESCRIPTION OF PROJECT

Location

The Lehigh River has its headwaters in the Pocono Mountain region of eastern Pennsylvania, at the northern terminus of the economically depressed Appalachian region. The Lehigh flows south and east for seventy-five miles before meeting the Delaware River seventy miles above Philadelphia at Easton, Pennsylvania. Figure VIII-1, the Study Area Map, shows the general location of the Lehigh Basin and the important features of the area.

The proposed site of the-Beltzville Dam is on Pohopoco Creek, a tributary of the Lehigh River. The site is five miles from the confluence of the Pohopoco and the Lehigh. Pohopoco Creek joins the Lehigh thirty-six miles above Easton (see Figure VIII-1).

Streamflow

Average flow of the Lehigh River at the Bethlehem gage which has a drainage area of 1,279 square miles (94 percent of the 1,364 square miles in the Basin) is 2,291 cfs (1,480 mgd), based on 52 years of record. Maximum daily discharge was 92,000 cfs (59,400 mgd) and the minimum one-day discharge was 205 cfs (132 mgd). The minimum daily discharge expected once in 50 years is 260 cfs (168 mgd). The river flows rapidly in its upper reaches but is slowed somewhat by many small dams in the lower reaches. Behind some of the small dams pleasure boating is possible.

Pohopoco Creek, the tributary on which the proposed dam will be located, has a drainage area of 109 square miles which yields an average annual flow of 227 cfs (147 mgd). It is a small mountain stream which flows swiftly in a rock-strewn bed.

Water Quality

The United States Geological Survey performed chemical analyses on samples from the Lehigh River during water year 1962. The Public Health Service surveyed the stream during July and August 1957. Results of these analyses are shown in Table III-1.

The water quality of the Lehigh River has improved since World War II. The installation of waste treatment plants by municipalities and industries, and the closing of many small anthracite coal mines have been important causes.

Oxygen content of the water is presently sufficient to permit fish to exist, based on samples taken by the Pennsylvania Department of Health.

Concentrations of phenols and cyanides which exceed the Public Health Service limits (after treatment) for drinking water (6) have been reported below Bethlehem. (The Lehigh River below Bethlehem is not used for municipal water supply.)

Existing and projected waste loadings are discussed further in Section VI.

Proposed Development Plan for Delaware River Basin

The Corps of Engineers, in cooperation with all interested Federal agencies, prepared a development plan for the Delaware River Basin. This plan was published as the Delaware River Basin Report (1) in 1960. Nineteen major developments were proposed to satisfy the water resources needs in the Delaware River Basin through the year 2010.

Eight major developments were proposed for the region above Trenton, New Jersey, the head of the Delaware Estuary. Four proposed projects, including Beltzville, are located in the Lehigh River Basin. The Lehigh Basin projects are shown in Figure VIII-1.

Beltzville Dam - Pertinent Data

The Corps of Engineers has proposed the inclusion of 40,000 acre-feet of active long term storage for water supply in the Beltzville Reservoir development. Total capacity proposed by the Corps of Engineers is 68,200 acre-feet.

The net drainage area above proposed Beltzville Dam site is 75 square miles. An additional 22 square miles located above the Beltzville site are tributary to Wild Creek and Penn Forest Reservoirs, sources of water for Bethlehem, Pennsylvania.

IV. DESCRIPTION OF STUDY AREA

Location and Boundaries

The Lehigh River Basin is located in eastern Pennsylvania. Drainage area of the Lehigh River Basin is 1,364 square miles.

The hydrological boundaries of the Lehigh River Basin were used as the limits for the projection of municipal water supply needs and municipal waste discharges.

The economic study area used as the basis for industrial water supply and waste discharges was the three county (Carbon, Lehigh and Northampton) region. The population of the three county region is greater than the population within the hydrological confines - 482,000 compared to 434,000. The major water using industries are within the hydrological confines of the Lehigh Basin.

The areas which are within the hydrological confines of the Lehigh River Basin, but are not located within Carbon, Lehigh, or Northampton Counties, are essentially rural in nature, with the exception of Hazelton (Luzerne County). The water supply needs of Hazleton, located 15 miles west of the proposed dam, were not considered in detail, as it was concluded they could be satisfied more economically from other sources.

Geography

The Lehigh River has its headwaters in the Pocono Mountains, a sparsely populated resort area dotted with lakes and small farms. The river traverses a portion of the Interior Plateau before cutting through the Appalachian Folds. In this area the river receives some acid mine wastes from scattered

Table No. III - 1

Water Quality - Lehigh River at Easton
(all values in milligrams per liter)

Constituent	U.S.G.S. Analysis (Oct. 1961 - Sept. 1962)		PHS Analysis (July, Aug., 1957)
	Average	Extreme	Average
Dissolved Solids	157	206	-
Dissolved Oxygen	-	-	5.9**
Hardness	149	194	132
Alkalinity	-	-	86
Iron	0.02	.06	.34
Manganese	0.02	.21*	-
Sulfate	45	58	-
Chloride	11	18	-
Fluoride	0.4	0.8	-
Nitrate	9	15	-
pH	7.1	7.0 - 7.4	-
Temperature	-	-	80°F
Annual	58°F	-	-
Monthly	-	77°F	-
Max. day	-	86°F	-
Color	3 units	5 units	-
Turbidity	-	-	8 units

* next highest value was 0.03 mg/1.

** minimum value was 5.4 mg/1.

deep mines, most of which have been abandoned. The river continues across the Taconic Deformation Belt to Allentown and then follows the borderline between this belt and the formations of the Atlantic Highlands to its confluence with the Delaware at Easton, Pennsylvania. The basin is split by the Appalachian Folds which are located along the southern border of Carbon County and divide the hilly, wooded portion of the upper Basin from the more open and industrialized lower portion. Elevations in the Lehigh Basin range between 200 and 1,500 feet. The area north of the Appalachian Folds, which includes the Beltzville site, is particularly well suited for recreational use.

Climate

The climatology of the area is largely continental despite its proximity to the Atlantic Coast. Generally west to southwest air flows are responsible for the hot, dry weather which causes occasional summer droughts such as that of 1957. The annual temperature averages 51°F and the average precipitation is 44 inches per year. The outdoor recreation season generally starts in mid-June and continues to mid-September.

Principal Communities and Industries

The main industrial developments in the Lehigh River Basin are centered in and around Allentown and Bethlehem, the major cities within the Lehigh Basin. Allentown with a 1960 population of 108,000 supports a diversified industrial complex including a truck manufacturer, an electronic communications industry plant, several food products plants, and an

industrial gas plant. Bethlehem with a 1960 population of 75,000 is dominated by one large steel plant.

Textiles and cement are the most important products originating in the remaining area of the Lehigh Basin. Easton is the third largest community in the study area with a 1960 population of 32,000, not all of which is within the hydrological confines of the Lehigh Basin.

Other communities are shown on Figure VIII-1.

V. ECONOMY

Scope

Future municipal and industrial water demands and waste discharges are based on the projected economy of the area. Population data, used for the projection of municipal water use and discharge, were available for the area within the hydrological confines of the Lehigh River Basin. Employment data for the three major counties in the area of the Lehigh River formed the basis of industrial water use and waste discharge projections. The assumptions used in this study are, in general, based on the economic base study made by the Office of Business Economics for the Corps of Engineers (1).

Past and Present

Population within the hydrological confines of the Lehigh River Basin increased from 1940 to 1960. Table V-1 shows the population by county for the Basin. The population figures shown in Table V-1 are plotted in Figure V-1.

Employment in the extractive industries (mining, forestry, fisheries, and agriculture) has declined steadily since 1940 in the economic study area (Carbon, Lehigh, and Northampton Counties). Carbon County has

Table V-1

Population within the Lehigh River Basin

County	1940	1950	1960
Berks	3,626	3,858	4,243
Bucks	208	224	256
Carbon	47,239	44,862	42,314
Lackawanna	601	541	732
Lehigh	173,367	196,664	222,229
Luzerne	33,712	30,220	27,308
Monroe	4,997	5,522	6,986
Northampton	105,371	116,599	126,623
Schuylkill	3,947	3,328	3,188
Wayne	496	436	519
Total Basin	373,564	402,254	434,398
Percent increase over previous census	-	8.0	8.0

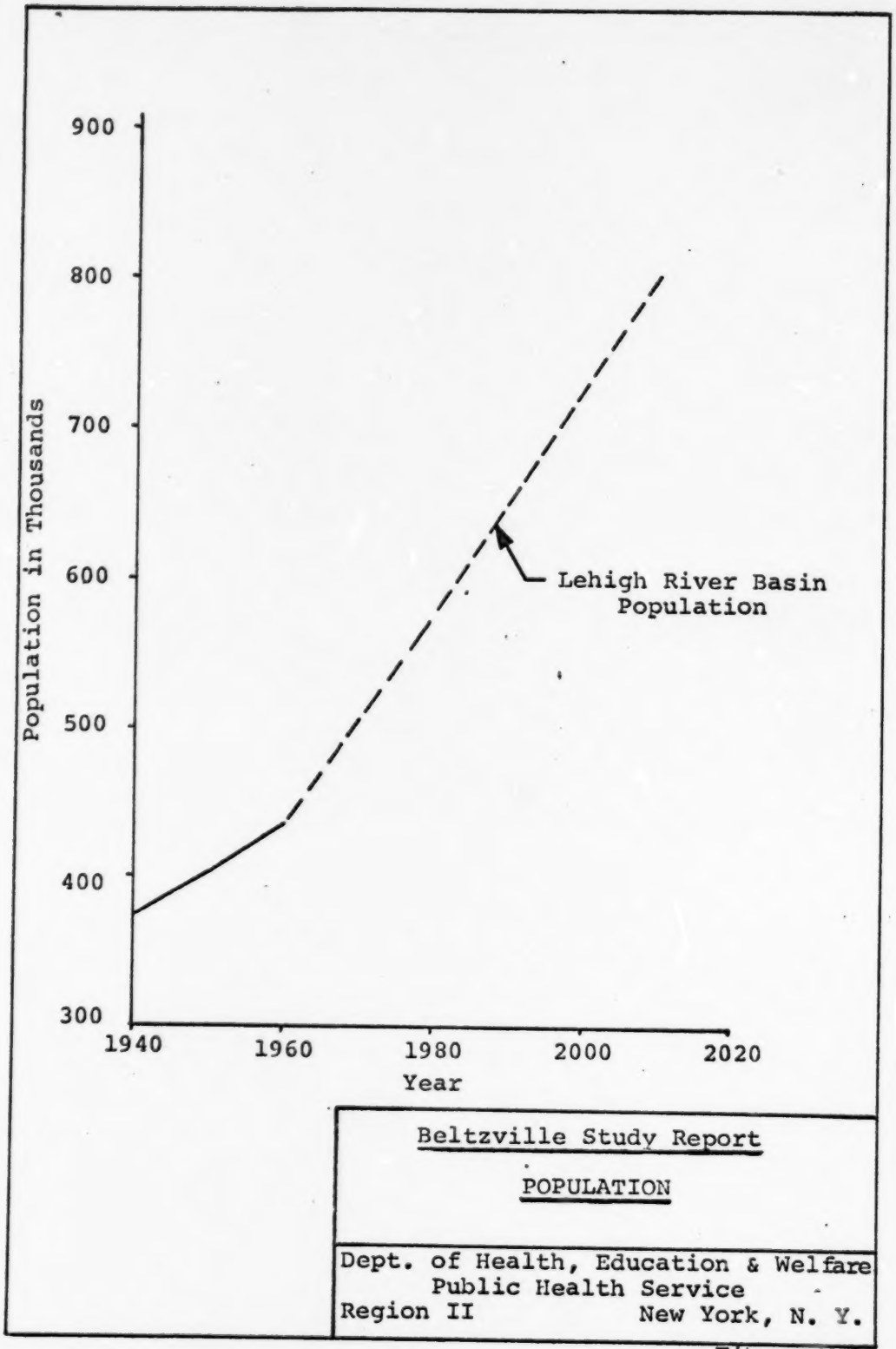
900
800
700
600
500
400
300
Population in Thousands
1940
1960
1980
2000
2020
Year
Lehigh River Basin
Population
Beltzville Study Report
POPULATION
Dept. of Health, Education & Welfare
Public Health Service
Region II
New York, N. Y.

Figure V-1

TABLE V-2

Employment Composition

Number and Percentage of Total Labor Force

	1940		1950		1960	
	Employees	%	Employees	%	Employees	%
Extract. Industries	13,300	7.8	11,300	6.0	4,500	2.2
Agriculture	(7,000)		(6,100)		(3,300)	
Mining	(6,300)		(5,200)		(1,100)	
Construction	5,800	3.4	8,500	4.5	9,200	4.6
Manufacturing	70,900	41.9	87,900	46.5	94,500	47.0
Primary Metals	(23,100)		(23,900)		(23,700)	
Apparel	(11,500)		(18,300)		(20,100)	
Other	(36,300)		(45,700)		(50,700)	
Other	63,400	37.5	73,100	38.7	83,800	41.6
Total Employment	153,400	90.6	180,800	95.7	192,000	95.4
Unemployed	16,000	9.4	8,200	4.3	9,200	4.6
Total Labor Force	169,400	100	189,000	100	201,200	100
Population (3 Counties)	408,200		441,000		481,800	
Labor Force as Percent of Population		41.5		42.8		41.7

experienced a serious drop in mining employment. Employment in mining for the three county area, has dropped from 6,265 in 1940 to 1,120 in 1960, with most of this decrease occurring in Carbon County. Agricultural employment in the area has also seriously declined since 1940. These figures are summarized in Table V-2.

Manufacturing employment has increased since 1940 in the study area. This sector of the economy is dominated by the primary metals industry. Another major component is the apparel industry. These figures are also summarized in Table V-2.

Other employment categories account for the remainder of the employment in the study area. Included in the "other" classification are transportation, communications, finance, government, and retail trade employees.

Data from the U. S. Census of Manufacturers (11) forms the basis of Table V-3. These figures indicate that productivity (both gross and per capita) has increased in the area.

Table V-3

Employees and Value Added by Manufacturer
(3 County Area)

Year	Number of Employees	Value Added by Manufacture in Thousands of Dollars *	Value Added per employee in Thousands of Dollars *
1947	86,856	469,797	5.41
1954	87,562	617,285	7.05
1958	85,423	641,244	7.51

* Adjusted to the 1957-1959 value of the dollar.

More specific data is shown in Table V-4 for the principal water using industries.

Table V-4

Municipal Water Using Industries

1960 Employment

Category	1960
Population (3 County Area)	482,000
Employment - Total	192,000
Percent of population	39.8%
Manufacturing employment	94,500
Percent of total employment	49.2%
Food and kindred products	5,000
Percent of manufacturing employment	5.3%
Chemicals and Allied Products	2,600
Percent of manufacturing employment	3.8%
Primary metals industries	23,600
Percent of manufacturing employment	25.0%
Hydraulic Cement	4,100
Percent of manufacturing employment	4.3%

Future

Population was projected for both the area within the hydrological confines of the Lehigh River Basin and the three county study area. The first area was used in this study for municipal water use projections. The three county area was used in the industrial projections. Population projections were needed in the latter case to aid in the employment projections. For both areas the basic growth rates were derived from the appropriate projections made by the Office of Business Economics.

Population for the area within the hydrological limits of the Lehigh River Basin is expected to increase from 434,000 in 1960 to 575,000 in 1980 and 800,000 in 2010. Population in the three county economic study area is expected to increase from 482,000 in 1960 to 640,000 in 1980 and 900,000 in 2010 as shown by Table V-5 and Figure V-1.

Table V-5

Present and Future Population

Area	1960	1980	2010
Lehigh River Basin (hydrological limits)	434,000	575,000	800,000
3 County Area	482,000	640,000	900,000

The population of Lehigh and Northampton Counties is expected to increase at a more rapid rate than Carbon County. The growth in these areas is expected to center around the existing manufacturing and commercial cities.

Total employment, manufacturing employment, and employment projections in the principal water using industries were made for the three county economic study area. Estimates by OBE show that by 2010, the population and labor force of the Delaware Area will have doubled; the flow of personal income will have quadrupled; and average incomes in real terms will be twice their 1955 level. Manufacturing growth in the major portion of the Lehigh Basin region has exceeded the national average in the past. In view of the importance of manufacturing in this area, total employment growth is projected at almost the same rate as that for the entire Delaware Basin.

Future manufacturing employment projections for the major water using industries are shown in Table V-6.

Table V-6

Major Water Using Industries

Employment Projections

Category	1980	2010
Population (3 County area)	640,000	900,000
Employment - Total	260,000	355,400
Percent of population	40.6%	39.5%
Manufacturing employment	122,600	181,300
Percent of total employment	47.2%	51.0%
Food and kindred products	6,400	9,200
Percent of manufact. empl.	5.2%	5.1%
Chemicals and allied products	4,000	7,700
Percent of manufact. empl.	3.3%	4.2%
Primary metals industries	37,000	58,000
Percent of manufact. empl.	30.2%	32.0%
Hydraulic cement	5,300	7,800
Percent of manufact. empl.	4.3%	4.3%

The detailed projections in Table V-6 are based on the assumption that the particular industries will grow at nearly the same rate in the Lehigh Basin as they do in the larger Delaware Basin region. The largest discrepancy between the Lehigh and Delaware growth rates occurs in the primary metals classification, where the Lehigh growth has been projected as 57 percent between 1980 and 2010, and the Delaware growth as 67 percent for the same period.

VI. WATER REQUIREMENTS

Present Withdrawals - Municipal

Municipal water supplies in the Lehigh Basin served 344,000 people in 1962 with an average of 51 mgd. Per capita usage in the basin averages about 150 gpd. Industrial water use of municipally supplied water and the lack of fully metered systems (meters usually reduce municipal water usage) raise the per capita demand above that in some similar sections of the country.

Table VI-1 shows the 1962 municipal water use within the Lehigh River Basin.

Table VI-1

1962 Municipal Water Use

Municipal Supply	Population (Thousands)	Total Use (MGD)	Use per Capita (GPD)
Allentown Area	115	22	195
Bethlehem Area	95	17	180
Northampton Area	30	1	50
Other Municipalities	104	11	100
Total	344	51	

Present Withdrawals - Industrial

Self-supplied industrial water use in the three county study area was estimated to be 470 mgd in 1962. The last comprehensive survey of industrial usage was made in 1955 at which time the demand was 367 mgd. The estimated 1962 demand was calculated from industrial employment figures and estimates of productivity changes since 1955.

Present Withdrawals - Agricultural

A detailed study of agricultural usage was not made in 1962. In the Delaware River Basin Report (1) the 1955 agricultural demand for the three county study area was 0.5 mgd. Based on the projections made in the aforementioned report the estimated 1962 agricultural demand was 2 mgd.

Existing Sources - Municipal

The major portion of the municipal demand, 38 mgd of the 51 mgd total, is satisfied from surface sources. Ground water sources provide the remaining 13 mgd.

Allentown

The City of Allentown currently supplies an average of 22.3 mgd. Two springs (11 mgd) and the Little Lehigh River (30 mgd) can provide 41 mgd. The water taken from the Little Lehigh is filtered and chlorinated. The spring water is only chlorinated. There are no serious quality problems.

Bethlehem

The City of Bethlehem has two impoundments on Wild Creek, a tributary of Pohopoco Creek. These two reservoirs can satisfy an average demand of approximately 28 mgd in 98% of all years. The 1962 demand averaged 17 mgd.

Northampton

Northampton Borough Municipal Water Authority presently supplies an average of 1.4 mgd. The Authority has a reservoir on a small tributary of the Lehigh but during extended dry periods this reservoir is of little use. During these periods the Lehigh River supplies essentially all the demand. Filtration and chlorination are provided for water from both sources.

Other Municipalities

Hazleton, another community partially in the Lehigh Basin, draws a portion of its water from small streams within the Basin. The majority of its demands are satisfied from sources in the Susquehanna River Basin.

Other communities in the Lehigh Basin use small surface impoundments and ground water to satisfy their demands. Northampton (discussed above) is the only community which presently utilizes the Lehigh River as a source of supply.

Easton

The City of Easton, a center of population which lies partly within the Lehigh Basin, uses the Delaware River as a source of water.

Existing Sources - Industrial

Of the total self-supplied industrial demand of 470 mgd it is estimated that 445 mgd is satisfied from surface sources. The remaining 25 mgd is supplied by ground water.

Bethlehem Steel Company is the largest water user in the area. The latest available figures (1960) indicate the Company's total intake was 230 mgd. The most important source is the Lehigh River from which the steel plant was drawing 212 mgd in 1960. Plant intakes are presently located below the outfall.

Existing Sources - Agricultural

The sources for the small quantities of agricultural water supply were not determined as part of this study.

Future Withdrawal Water Needs and Sources - Municipal

The examination of future water needs was based on the estimates of present use together with projected population growth and industrial expansion. Although municipal water supply needs outside the study area were considered, it was concluded that diversions from the Lehigh Basin are not presently significant and will not become significant during the study period.

Consideration of water supply sources used by communities in the Northeast indicated that municipalities frequently decide to forsake the lower stretches of major rivers as sources of supply in favor of upstream tributary streams and reservoirs. For example, as indicated above neither Allentown nor Bethlehem currently use the Lehigh River as a source of supply. The primary reason for this approach appears to be related to the higher quality of the upstream sources. In addition, this quality is usually less variable than that of the downstream sources. Therefore, the estimation of future sources of supply to meet projected demands should include a recognition of this practice as well as economic considerations and availability of the necessary quantity. However, even though the higher quality sources may be tapped first, future practice will probably differ from the present since disinfection plus treatment may be necessary for all surface sources of supply in Penna.*

Three major municipal water supply areas are expected to expand during the study period. These will be centered around Allentown, Bethlehem and Northampton. Each of these as well as the other minor

* Regulations for Public Water Supplies (13) Chapter 4, Article 443, Section 11C

C. Recreational Use
"All new sources using surface water and existing sources used for recreational purposes must be provided with filtration and disinfection facilities."

communities is discussed below. The municipal water use expected in 2010 for the three major areas and other municipalities is shown in Table VI-2.

Table VI-2

2010 Municipal Water Use

Municipal Supply	Population (Thousands)	Total Use (mgd)	Use Per Capita (gpd)
Allentown Area	272	65	240
Bethlehem Area	221	48	220
Northampton Area	71	9	125
Other Municipalities	236	28	120
Total	700	150	

Allentown

The City of Allentown has already been concerned with future water supply. The background data and preliminary conclusions from a report prepared by a private consultant for the City of Allentown have been made available to this study. The consultant's estimates of population and demand in 2010 were somewhat less than those shown in Table VI-2. The higher figures projected in this study result from a higher growth rate and an expansion in the existing service area. The per capita demand projected in this study is also higher than that estimated by the consultant.

Existing water supplies will provide 41 mgd of the expected average daily demand of 65 mgd in 2010. The additional demand of 24 mgd must be obtained from new sources.

To supply this additional demand for Allentown and its water service

area, the consultant has recommended that the City use the Lehigh River. On the Lehigh River, 18 miles above Allentown, the lowest one day flow under existing conditions in 14 years of record is 185 cfs (120 mgd). A request has been made to the Pennsylvania Department of Forests and Waters by the City of Allentown to reserve a portion of both the Lehigh River and Jordan Creek flows.

The consultant also considered the development of additional ground water sources and the use of the proposed Trexler Reservoir, one of the four multipurpose structures proposed by the Corps of Engineers for the Lehigh Basin.

The proposed Beltzville Reservoir could also supply this additional demand. While there are intangible benefits associated with upstream sources (as previously cited) it appears more likely that Allentown will utilize the Lehigh River.

Prior to the initiation of detailed planning on any future impoundment projects in the Lehigh Basin, the water supply requirements of Allentown should be re-evaluated to determine the relative desirability of alternate sources.

Bethlehem

The City of Bethlehem has also been concerned with future water demands. An extensive report (8) on the City's demands and needs has been made available to the study. The projections of 2010 demands have been based in part on the results of this Bethlehem report. As was the case with Allentown, the projections of population and water

demands presented herein exceed those made by the Bethlehem Municipal Water Authority. The Authority, at the time their projections were made was concerned with the period ending in the year 2000. The report was written after the Corps of Engineers had proposed their systems of reservoirs in the basin (1).

As indicated previously, Bethlehem's present Wild Creek system can satisfy an average demand of approximately 28 mgd in 98% of all years. Based on an estimated 2010 demand of 48 mgd (Table VI-2) and a 1962 demand of 17 mgd, it is probable that the demand will exceed the total yield of the existing supply by about 1975.

In anticipation of this projected demand, the City intends to develop the Tunkhannock Creek watershed which is located about 10 miles north of their existing system. The City has purchased 43% of the required land area. This development would be capable of providing about 12 mgd of the 20 mgd additional supply needed by 2010. Twelve (12) mgd would provide sufficient capacity to meet Bethlehem's needs to about 1995. The Bethlehem report suggested that following the development of the Tunkhannock supply the City may turn to ground water (they own deep wells which are not presently in use), the Lehigh River, Monocacy Creek or one of the reservoirs proposed by the Corps of Engineers.

Although Bethlehem's present plan does not include reliance upon the storage in the Beltzville reservoir, the additional supply of 20 mgd needed by 2010 could be satisfied from that project. The water from the existing Wild Creek development is presently and will continue to be transported to Bethlehem via a transmission main. It should be noted that this main passes through the proposed Beltzville Reservoir site.

The proximity of this main to the reservoir would lessen construction costs for the utilization of the Beltzville water supply. It appears likely therefore that the Beltzville reservoir will be an attractive source to Bethlehem for the satisfaction of their projected water demands.

Northampton

Water demands in the Northampton Borough service area are expected to increase to 9 mgd in 2010. It is expected that Northampton will continue to use the Lehigh River if a more desirable source is not available. The lowest one day flow (14 years of record) in the Lehigh River ten miles above Northampton is 120 mgd. Hence, this is sufficient flow in the Lehigh to meet the expected 2010 demand of 9 mgd.

The Beltzville Reservoir could also be used as a source of supply to meet Northampton's future water demands. There are intangible benefits associated with the Beltzville Reservoir, although it appears more likely that Northampton will continue to utilize the Lehigh River to satisfy its future demands.

Other Municipalities

Many small communities in the Lehigh Basin will require additional water to satisfy 2010 demands. Based on a total use of 11 mgd in 1962 (Table VI-1) and an expected 2010 demand of 28 mgd (Table VI-2), these smaller communities will require the development of individual supplies totaling 17 mgd. To satisfy this total demand, some communities will continue to rely on ground water sources, others will utilize local surface impoundments, and some will draw on the Lehigh River.

It may be possible to serve the future water requirements of some of the communities from the Beltzville reservoir where transmission mains make it economically available to them, but at the present time a quantitative amount cannot be estimated.

The Delaware River Basin Commission has prepared a ground water report for the Lehigh Basin, which indicates the general range of quality and quantity of ground water for various geological areas of the Lehigh Basin (3). Ground water is available in the Basin in scattered locations. Sources yielding relatively small amounts of water suitable for municipal and most industrial uses are widespread.

Easton

The City of Easton uses the Delaware River as a source of water. The Delaware River at Easton is of excellent quality and has sufficient flow to meet Easton's needs. Hence, it appears likely that Easton will continue to use the Delaware River as a source of water supply.

Future Withdrawal Water Needs and Sources - Industrial

Demands

Future water needs of the industries in the three county study area are based on the growth projected for the area (see Section V).

Table VI-3 gives estimates of total water intake, process water, cooling water, gross water use, recirculation ratios, and total water discharge for each of the four major classifications of water using industries in the Lehigh area. The breakdown of the intake figure into general types of in-plant use is based on the 1959 census of industrial water use (12). In addition to using water for various processes and

cooling, water is needed by industry for boiler feed, power generation and other purposes.

It was assumed in this study that increasing water costs and technological advances will result in increased internal recirculation of water. It was also assumed that the demands of the industries not shown in Table VI-3 will be satisfied from muncipal supplies and are relfected in the projection of the per capita use rates.

Sources

Industry will use surface water sources to supply approximately 95 percent of its demands. The remaining needs will be supplied by ground water.

With the possible exception of the "primary metals" industry existing surface water flows will be sufficient to satisfy industrial demands. The primary metals industry in the Lehigh Basin is dominated by the Bethlehem Steel Company, which presently employs approximately 70 percent of the workers in the classification. Assuming that Bethlehem Steel Company will use 70 percent of the water projected for the primary metals industry in 2010 their intake demands will be 945 mgd.

However, it is worthwhile to note that the Bethlehem Steel Company has already located their plant intakes below their outfalls, at least for a portion of their demands. With this system, which utilizes the Lehigh River as a source of supply, no shortage of water can occur until the consumptive loss of the industry equals the river flow. The consumptive loss projected for the entire primary metals industry in Table VI-3 (55 mgd) is

TABLE VI-3

Future Industrial Water Demands

Industry	1980	2010
Primary metals		
Total water intake	600 mgd	1350 mgd
Process	145	330
Cooling	255	570
Gross water use	1020	2765
Recirculation ratio (in-plant)	1.7	2.0
Total water discharged	575	1295
Chemicals and allied products		
Total water intake	55	125
Process	10	20
Cooling	35	85
Gross water use	90	250
Recirculation ratio (in-plant)	1.6	2.0
Total water discharged	50	115
Food and kindred products		
Total water intake	20	75
Process	5	15
Cooling	15	50
Gross water use	70	335
Recirculation ratio (in-plant)	3.5	4.5
Total water discharged	18	70
Stone, clay and glass (cement)		
Total water intake	65	65
Process	5	5
Cooling	10	10
Gross water use	110	110
Recirculation ratio (in-plant)	1.7	1.7
Total water discharged	58	58
Total of listed industries		
Total water intake	740	1615
Process	165	370
Cooling	315	715
Gross water use	1290	3460
Recirculation ratio (in-plant)	1.7	2.1
Total water discharged	701	1538

considerably less than the projected 2010 streamflow at Bethlehem (128 mgd, the natural daily average flow in 98 percent of all years minus projected losses above Bethlehem).

Therefore, based on existing knowledge, no need for storage to supply industrial water demands is currently foreseen for the study period. This assumes that future low flows will correspond to those recorded prior to 1962. It also assumes that water quality goals as discussed in the following paragraphs will be met.

Stream Quality Maintenance

Under provisions of the Federal Water Pollution Control Act, Public Law 84-660, as amended by Public Law 87-88, in the survey or planning of a reservoir by any Federal agency, consideration must be given to the inclusion of storage for regulation of streamflow for the purpose of water quality control. The law expressly states that any such storage and water releases shall not be provided as a substitute for adequate treatment of wastes.

The Beltzville Dam and Reservoir was proposed in the Delaware River Basin Report (1), published in 1960. This was prior to the amendment of Public Law 84-660 by Public Law 87-88. However, the proposed development is subject to the provisions of this law as amended.

Discharge of municipal and industrial wastes, even when adequately treated, will cause an unsatisfactory quality condition in receiving waters whose waste assimilation capacity is exceeded. This condition usually, but not always, occurs during periods of low flows and high water temperatures. Poor quality conditions may be avoided by maintaining flows at higher levels.

The storage recommended in this report for streamflow regulation will maintain the dissolved oxygen concentration at or above 5 milligrams per liter in 24 of 25 years during the study period. The desirability of maintaining water quality at this level is discussed further in Section VII.

Present Waste Loads

It is estimated that treated wastes representing 29,000 pounds of first stage biochemical oxygen demand (BOD) are discharged each day to the Lehigh River or its tributaries. For purposes of comparison this represents approximately the raw waste which would be discharged from a municipality of 116,000.

Treatment of wastes reduces the BOD (biochemical oxygen demand). This, then, results in greater concentrations of dissolved oxygen, a desirable constituent, in the waters which receive the treated wastes.

Table 1A (Municipal Wastes Inventory) and Table 2A (Industrial Wastes Inventory) of the Appendix were compiled from the Delaware River Basin Commission's 1963 listing of waste treatment facilities in the Lehigh Basin. Of the ninety-two sub-divisions partially or wholly within the Lehigh Basin, nineteen, including Allentown and Bethlehem, provide secondary treatment, one provides primary, and nine discharge raw wastes. Households in the remaining sixty-three sub-divisions are served by individual disposal systems (not listed in Table 1A unless abatement measures are considered necessary by the Commission).

Fifteen of the forty Basin industries provide primary treatment, nine provide secondary, eight discharge to municipal systems, two utilize sub-surface disposal methods, one is unknown. Five industries are discharging untreated wastes. The total BOD load presently discharged by industry is close to that discharged by all municipalities and institutions.

Current pollution abatement needs for both municipalities and industries, set forth by the Delaware River Basin Commission, are shown in the appended inventories.

The Lehigh River above Jim Thorpe (and the Beltzville site) is currently classified as an acid stream by the Pennsylvania Sanitary Water Board. No treatment is presently required by the Board for municipal wastes discharged to this section. Industrial wastes of organic nature must receive primary treatment. From Jim Thorpe to a point just above Palmerton the Board requires primary treatment for municipal and organic industrial wastes. Secondary treatment is required for all municipal and organic industrial wastes discharged between Palmerton and the confluence of the Lehigh River with the Delaware River. Treatment requirements for inorganic industrial wastes are based on the specific nature of the waste. The requirements for the Lehigh River tributaries are essentially the same as exist in the main stem at the confluence of the tributary.

Waste Load Projections

Projections of waste loads for the years 1980 and 2010 assumed that all wastes would receive secondary treatment before discharge to the Lehigh River. The total effluent load from municipalities and industries in 1980 is expected to be 35,000 pounds of first stage BOD per day. By the year 2010 it is anticipated that the load will be 59,000 pounds per day.

Effect of Waste Loads

Waste loads affect several aspects of water quality. Concentrations of dissolved oxygen, solids, and bacteria are among those frequently used

to determine the acceptability of a stream for its intended use. For purposes of this study the dissolved oxygen content of the stream was examined most closely.

Before any major water storage facilities could be completed and put into use the need for such facilities will exist. Using the waste loads anticipated in 1970 and the annual streamflow conditions expected once in 25 years the minimum dissolved oxygen near Easton will be less than that necessary for a desirable fish population (5 milligrams per liter). In the year 2010 the same streamflow conditions, together with the higher waste loads projected for that year, would cause the dissolved oxygen to be less than 5 milligrams per liter for as long as four months. During the most critical month the dissolved oxygen would average less that 2 milligrams per liter. In addition to causing poor quality conditions in the Lehigh River the dissolved oxygen content of the Delaware River at its confluence with the Lehigh would be reduced significantly.

Effect of Increased Streamflow

The annaul draft on storage (above reservoir inflows)* necessary to maintain the dissolved oxygen content of the Lehigh River above 5 milligrams per liter in 24 out of 25 years through 2010, is estimated to be 110,000 acre-feet (including 20 percent to compensate for operational losses in synchronizing releases with downstream needs).

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* For purposes of this report the annual draft on storage is defined as the sum of the incremental excesses of needed releases over inflows during a climatic year.

Approximately 60 percent of this draft would be necessary during the summer months, and the remaining 40 percent in the fall. The greater demand occurs during the summer because of the higher water temperatures.

Provision of Storage for Stream Quality Maintenance

There are no impoundments in the Lehigh Basin which contain storage for water quality control. The comprehensive plan developed by the Corps of Engineers includes the provision of 158,000 acre-feet of storage for purposes of water supply. Hence, the required storage of 110,000 acre-feet for water quality control could be satisfied under this comprehensive plan.

Reservoir Operation

The primary objective of the regulation of the storage provided for water quality control is to maintain satisfactory dissolved oxygen concentrations in the Lehigh River of 5 mg/l. In order that this objective can be met the following recommendations are made:

1) The reservoir site should be cleared completely to reduce the oxygen demand that results from decaying vegetation.
2) Releases should be based on observations of stream quality.
3) Multiple outlets should be provided at the reservoir to permit flexibility in operation to assure the release of high quality water.

4) Monitoring equipment should be provided so that necessary information on the quality of water released will be available for operation.

VII. BENEFITS

Water Supply

Estimated Quantitative Benefits

The withdrawal of 20 mgd directly from the Beltzville reservoir to satisfy the future requirements of Bethlehem formed the basis for estimating quantitative water supply benefits. As indicated in the previous section, it does not appear likely that the other areas of future water supply demand will utilize Beltzville storage for the satisfaction of their needs. Approximately 6000 acre-feet of storage would be required to satisfy a demand of 20 mgd. In order to evaluate the quantitative benefit resulting from the satisfaction of this demand, the cost of achieving the same quantity of flow by the most likely alternative may be used as an approximation.

The cost of developing 20 mgd by alternative means was computed by using the cost of developing the Tunkhannock supply together with standard cost-yield figures. The Tunkhannock supply would be capable of providing about 12 mgd of the total of 20 mgd and is estimated to cost about $5,200,000 . The cost to develop the remaining 8 mgd utilizing single purpose reservoir would be about $4,940,000 . This results in a total first cost of $10,140,000 . Based on a project life of 50 years and an interest rate of 3.125 per cent for a federal project and a bonding period of 25 years and an interest rate of 4 per cent for municipalities, the annual cost would be $ 253,000. This cost is considered to be an estimate of the value or benefit of the water supply storage necessary to supply 20 mgd.

Desirability of Upstream Sources

The availability of high quality in an upstream reservoir has often been an attractive source to many communities. Indeed, municipalities have frequently forgone the development of a supply in the lower reaches of a major river in favor of an upstream supply. The primary reason for this appears to be related to the more dependable nature of the upstream supply in terms of its quality.

In the lower stretches of major river basins, water quality is generally lower and much more variable since it is influenced by upstream pollutants (even if treated), including agricultural drainage (herbicides and pesticides), municipal and industrial wastes and street drainage and storm water bypasses of sewage. This is in contrast to upstream tributary sources with little or no economic development. It is expected that the future water quality of the lower Lehigh River will be maintained at adequate or marginally satisfactory levels by a combination of adequate waste treatment and recommended levels of flow regulation (see below). However, the water in this lower stretch of the Lehigh will always be threatened by increasing waste loads as well as occasional spills of industrial chemicals and will certainly be of a generally inferior quality than that available at upstream sources.

Water Quality

Estimated Quantitative Benefits

Without streamflow regulation it is estimated that the waste loads projected for the year 2010 would result in a dissolved oxygen

concentration in the Lehigh River above Easton of less than 2 milligrams per liter, at flow levels expected once in 25 years. With existing flows, this condition could persist as long as one month. The dissolved oxygen concentration would average less than a desired level of 5 milligrams per liter for four months of the year under the same conditions. This means that aquatic life such as fish will leave the area in favor of waters that more nearly provide the environment they require.

When no adequate means are available to evaluate directly the economic effects of water quality maintenance or improvement, the cost of achieving the same results by the most likely alternative may be used as an approximation of the benefits.

Consideration was given to the transport of treated wastes from Allentown and Bethlehem via pipeline to the Delaware River. This plan was rejected for two reasons. First, the quality of the Delaware River would be decreased to undesirable levels, and second, the diversion of waste flows from the Lehigh River would be likely to deprive some users of adequate quantities of water.

The provision of storage to permit streamflow regulation was chosen as the most feasible method of assuring suitable water quality. In view of the multi-purpose Beltzville reservoir the necessary storage could be provided by raising the existing Walters Dam and by the construction of a single purpose reservoir at the Beltzville site. Approximately 70,000 acre-feet of storage at Walters Dam and approximately 40,000 acre-feet of storage in a single purpose reservoir at the Beltzville site would be needed to provide the desired quality in

the Lehigh River in 2010. The initial cost of this storage would be $18,000,000. Based on the estimates made as part of this study, streamflow regulation will be necessary in 1970. Based on a 50 year project life and an interest rate of 3.125 per cent, the annual cost would be $866,000, including $133,200 for operation, maintenance, and the economic cost of the land. This cost is considered to be an estimate of minimum values of benefits.

The Beltzville multi-purpose project contains 34,000 acre-feet of storage which could be allocated for purposes of streamflow regulation to permit water quality control. The most feasible alternative to the inclusion of this storage in the Beltzville project would be the provision of a similar amount of storage at the Walters Dam. The estimated first cost is $4,630,000; the annual cost would be $217,000, including $34,000 for operation, maintenance, and the economic cost of the land, assuming a project life of 50 years and an interest rate of 3.125 per cent.

General Need for Improved Quality

The provision of adequate water quality in the Lehigh River will assure recreational opportunities for the anticipated 2010 population of more than 400,000 people in the Allentown-Bethlehem area. Fishing, boating and swimming opportunities will be improved by the provision of good quality water. Approximately fifteen miles of the Lehigh River will benefit substantially from the provision of good quality water.

In addition to recreational benefits riparian owners and other users will enjoy improved aesthetics as a result of clean surface waters and satisfactory public health conditions in the water related environment. Availability of water of more uniform quality, as well as sufficient quantity will favor industrial growth. The increased flows provided for water quality improvement will also benefit industry by reducing the cost of cooling. It must be recognized however, that increased flows are not the only necessary feature of a water quality management plan. Adequate treatment of wastes including disinfection, the elimination of toxic contaminants, and cooling, will be needed in addition to the provision of increased flows if the benefits envisioned are to be realized.

The provision of storage for water quality control will also be a valuable tool in the control of transient water quality conditions, such as those that result from the closing of a waste treatment plant for repairs.

Provision of the required storage for streamflow regulation as recommended losses will tend to lessen water treatment costs. Property values will be maintained and enhanced in areas contiguous to the streams. Availability of a water supply of assured quality as well as quantity will be an inducement to industry to select plant sites in the study area, all other things being equal. Recreation will be maintained and enhanced.

In addition to the Lehigh River the Delaware River from Easton to Trenton, New Jersey, a distance of 50 miles, will also benefit from improved water quality although to a considerably less degree. The benefits will be of the same general nature as those in the Lehigh River, but less in magnitude because of the higher natural flows in the Delaware River.

From the above, it is concluded that benefits are widespread in scope, and sufficient in magnitude to justify and warrant the provision of the indicated volume of storage for the required streamflow regulation.

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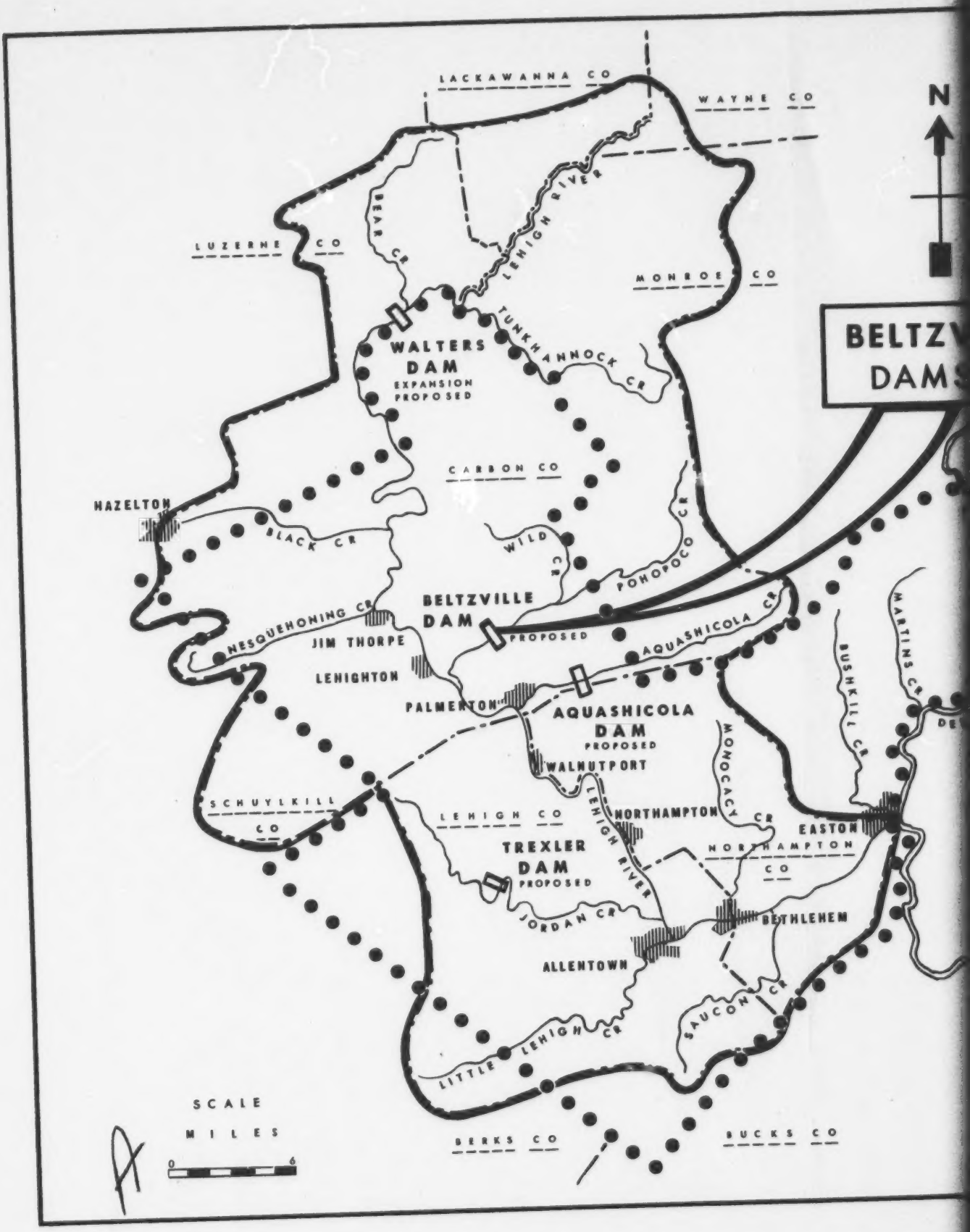
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PROPOSED
TUNKHANNOCK CR
CARBON CO
HAZELTON
BLACK CR
WILD
POHOPOCO CR
BELTZVILLE
DAM
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NESQUEHONING CR
JIM THORPE
AQUASHICOLA CR
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BUSHKILL CR
WALNUTPORT
MONOCACY CR
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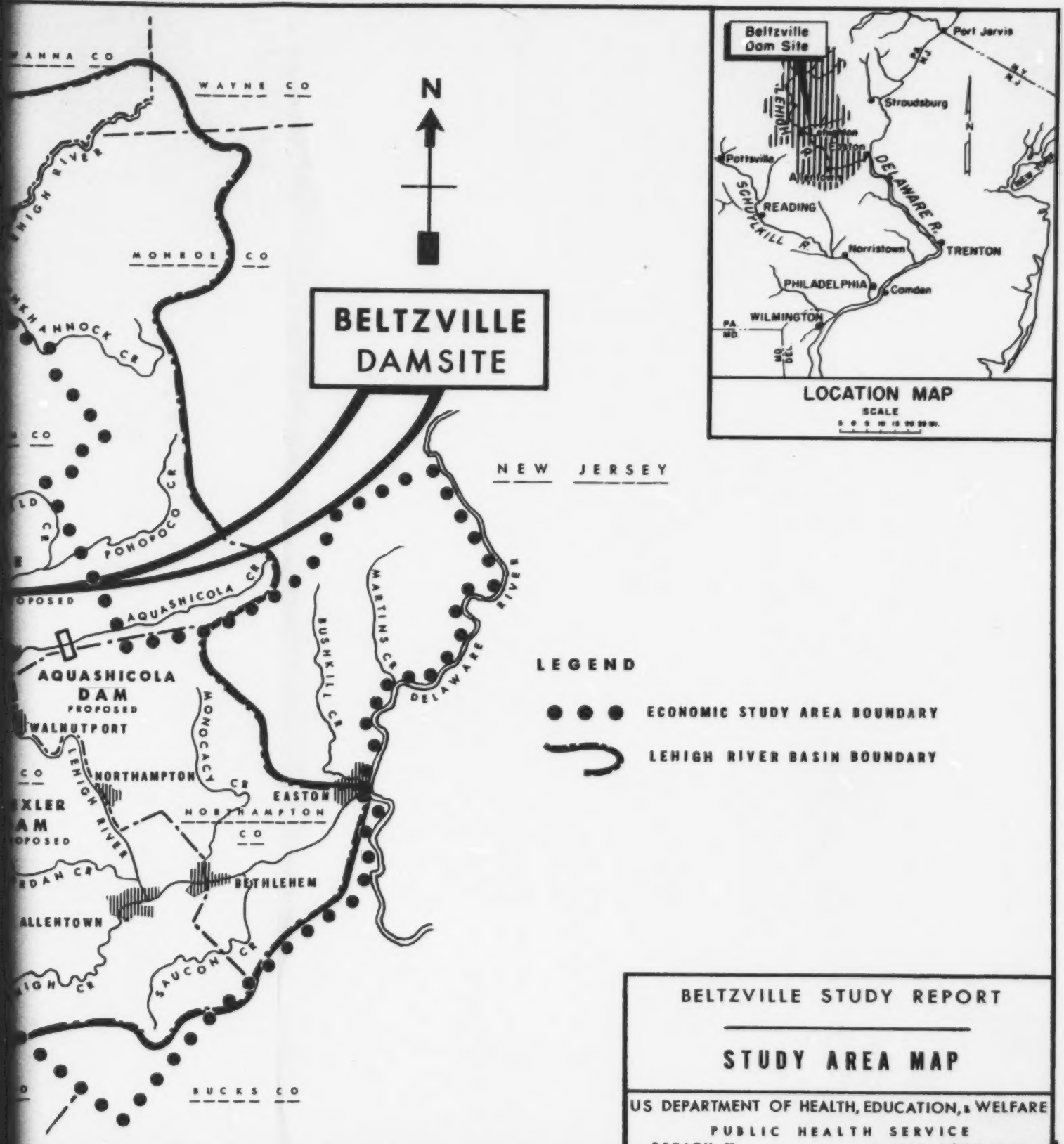

BELTZVILLE STUDY REPORT

STUDY AREA MAP

US DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION II NEW YORK, N. Y.

FIGURE VIII

TABLE 1A

Municipal Waste Inventory - 1963
(Data from Delaware River Basin Commission)

County Sub-Division	Population Served	Degree of Treatment	Abatement Needs
Berks			
Topton	3000	Secondary	None
Carbon			
Banks Twp. (Tresecow)	1100	None	New Plant
Beaver Meadows	1400	None	New Plant
Jim Thorpe	6000	None	New Plant[1]
Lehighton	6500	Primary	None
Mauch Chunk	2714	None	New Plant
Palmerton	8000	Secondary	None
Weatherly	2000	None	New Plant
Lehigh			
Allentown	130,000	Secondary	None
Catasauqua	5000	Secondary	None
Coplay	3721[2]	(Note 2)	System and Plant
Macungie	1266[2]	(Note 2)	System and Plant
Slatington	4300	Secondary	None
South Whitehall	(2000)	To Allentown	Extensions[3]
Luzerne			
Foster	1195	None	New Plant
Freeland	2500	None	New Plant
Hazel	1000	None	New Plant[4]
Hazelton	20,000	None	New Plant[4]
White Haven	2000	Secondary	None
Northampton			
Bath	1736[2]	(Note 2)	System and Plant
Bethlehem	84,600	Secondary	None
Freemansburg	(1500)	To Bethlehem	Extensions[3]
Lower Saucon	(1000)	To Bethlehem	Extensions[3]
Northampton	9000	Secondary	None
Walnutport	1609[2]	(Note 2)	System and Plant

Notes:

1. Received permit for primary plant 8-63 from Pa. Dept. of Health.
2. Population served by individual sub-surface disposal systems.
3. Remainder of population is still served by individual systems.
4. Orders issued 8-63. Plant will discharge to Susquehanna River when completed, according to Pa. Dept. of Health.

APPENDIX

TABLE 2A

Industrial Waste Inventory - 1963
(Data from Delaware River Basin Commission)

County Industry	Employees 1960	Waste MGD	Degree of Treatment	Abatement Needs
Carbon County				
No.Amer. Realtory Sand	17	.2	Primary	None
N.J. Zinc of Pa.(E. Plant)	-	-	Secondary	None
N.J. Zinc of Pa.(W. Plant)	-	5.0	None	New Plant
N.J. Zinc of Pa.(W. Plant)	1800	.2	Secondary	None
Heintzelman Bros.	-	.0	Primary	None
Lehigh County				
M. Feder Co.	-	-	-	Undetermined
Lehigh Struct. Steel Co.	500	.2	Secondary	None
Western Electric Co.	3500	.7	Primary	None
L. F. Grammes & Sons	510	.3	To Mun.Sys.	None
General Electric Co.	700	.7	Secondary	None
Allentown Converting Co.	-	-	To Mun.Sys.	None
Arbogast & Bastion	400	.0[1]	To Mun.Sys.	None
Neuweiler's Brewing Co.	143	.3	To Mun.Sys.	None
Horlacker Brewery Co.	100	.4	To Mun.Sys.	None
Enamel Strip Co.	-	-	To Mun.Sys.	None
Electric Storage Battery	223	.2	Deep Wells	Survey
Superior Metal Products	-	-	To Mun.Sys.	None
Eagle Brewing Co.	64	-	None	Connect[2]
United Dyeing & Fnshg. Co.	62	-	None	Connect[2]
Willaim Moskalski	-	.0	Secondary	None
Trojan Powder Co.	560	.4	Primary	None
Air Products, Inc.	1200	.1	Secondary	None
N. J. Zinc of Pa.	200	1.5	Primary	None
N. J. Zinc of Pa.	200	.0	Secondary	None
C. K. Williams Co.	-	.1	Secondary	None
Keystone Lamp Works	-	-	Secondary	Additions
Luzerne County				
Atlas Powder Co.	-	-	Ind.System	Improvements
General Crushed Stone Co.	21	-	Primary	None
Luzerne Co. Gas & Elec.Co.	-	-	None	Undetermined
Admiral Coal Co.	-	-	None	New Plant
Monroe County				
Coolbaugh Sand & Gravel	-	-	Primary	None
Sheely Sand & Gravel	-	-	Primary	None

TABLE 2A (cont'd.)

(Industrial Waste Inventory - 1963)
(Data from Delaware River Basin Commission)

County Industry	Employees 1960	Waste MGD	Degree of Treatment	Abatement Needs
Northampton				
National Portland Cement	230	20.0	Primary	None
Keystone Chemurgic Corp.	20	.0	Primary	None
Bethlehem Steel (Coke Oven)	-	.8	Primary	New Plant[3]
Bethlehem Steel (Mill Scale)	-	.3	Primary	New Plant[4]
Reichard Coulston, Inc.	83	.6	Primary	Additions
American Nickeloid Co.	-	.1	Primary	None
Lehigh Textile Processes, Inc.	52	.1	Minor[5]	Note[5]
Schuylkill County				
Refractory Sand Co.	-	.3	Primary	None

Notes:

1. Also 1.1 MGD cooling water.
2. Connection to municipal system.
3. Portion of this goes to municipal system.
4. Additions being constructed (1962).
   Also 230 MGD cooling water.
5. Propose to go to municipal system.